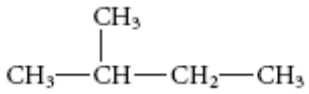
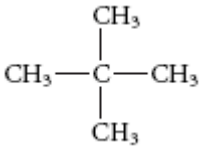
Unit 7 Chemical Changes of Organic Compounds
Chapter 14 Structure and Properties of Organic Compounds
Solutions to Practice Problems

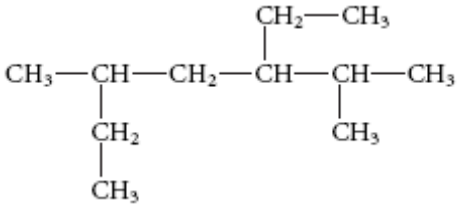
1.
Problem
Provide names for the following molecules:
a)



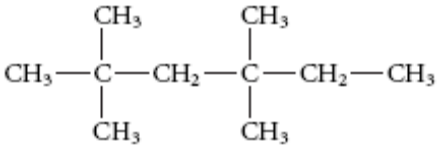
b)



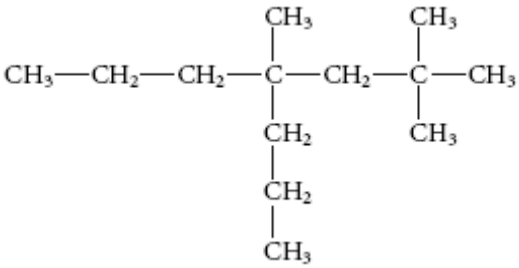
c)



d)



e)



What is Required?
You must name the given compounds.

What is Given?

The condensed structural diagram for each compound is given.

Plan Your Strategy

Step 1 Find the root: Identify the longest continuous main chain and count the number of carbon atoms in this chain. Use the appropriate numerical prefix to indicate the number of carbon atoms in the longest main chain.

Step 2 Find the suffix: Each compound is a saturated hydrocarbon that is an example of a branched alkane. The suffix for each compound will be *–ane*.

Step 3 Assign a position number: Identify all branches present. Number the longest continuous chain starting from the end that gives the lowest number to the first location at which branching occurs.

Step 4 Find the prefix:

- Number the branch by the number of main chain C to which it is attached. The branches are alkyl groups that are named by changing the *-ane* ending of the corresponding alkane to *-yl*.
- If more than one of the same type of branch alkane is present, name them using the appropriate number prefixes (*di-* for two, *tri-* for 3, *tetra-* for 4 etc.)
- If more than one type of branch is present, write the names of these sides groups in alphabetical order. Do not include the name of the prefix that shows the number of that type of branch.
- Use hyphens to separate words from numbers.
- Use commas to separate numbers.

Step 5 Name the compound: The name for the compound is made up as: prefix + root + suffix

Act on Your Strategy

a) The longest chain has 4 carbons. The root is –but. The main chain is numbered from left to right. A methyl group (CH_3–) is attached to carbon C2. The name is 2-methylbutane.

b) The longest chain has 3 carbons. The root is –prop. Two methyl groups (CH_3–) are attached to carbon C2 of the main chain. The name of the compound is 2,2-dimethylpropane.

c) The longest chain has 7 carbons. The root is –hept. The main chain is numbered from right to left so that methyl groups (CH_3–) are attached to carbons C2 and C5 and an ethyl group (C_2H_5–) is attached to carbon C3. The name is 3-ethyl-2,5-dimethylheptane.

d) The longest chain has 6 carbons. The root is –hex. The main chain is numbered from left to right. Four methyl groups (CH_3–) are attached: two are at carbon C2 and two are at carbon C4. The name is 2,2,4,4-tetramethylhexane.

e) The longest chain has 7 carbons. The root is –hept. The chain is numbered from right to left. There are 3 methyl groups (CH_3–): two are attached to carbon C2 and one is attached to carbon C4. A propyl group (C_3H_7–) is attached to carbon C4. The name is 2,2,4-trimethyl-4-propylheptane.

Check Your Solution

Check that the root corresponds to the number of carbon atoms in the longest continuous chain and that the alkyl groups are on the correctly numbered carbon atoms.

2.

Problem

Identify any errors in the name of each of the following hydrocarbons. (**Hint:** Where possible, draw the structures as named. Then examine the structures and rename them.)

a) 2,2,3-dimethylbutane

b) 2,4-diethyloctane

c) 3-methyl-4,5-diethyl-nonane

Solution

a) There are three methyl groups. The correct name is 2,2,3-trimethylbutane.

b) A condensed structural diagram of this compound will show that the longest continuous chain has nine carbon atoms (the ethyl group on carbon C2 should be counted as part of the main chain). The correct name is 5-ethyl-3-methylnonane.

c) The structure of the compound is possible but the name does not follow the accepted practice of having the branches listed in alphabetical order and a hyphen should not break up the prefix from the root. The correct name is 4,5-diethyl-3-methylnonane.

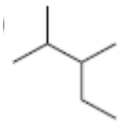
3.

Problem

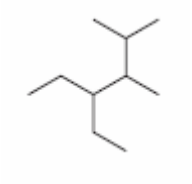
Name each of the following compounds:

a)

b)



c)



Solution

In a line structural diagram, the end of the line and each point at which lines meet represent a carbon atom. Sufficient hydrogen atoms are assumed to be around each carbon atom to fulfill the valence requirements for carbon. There are only single carbon-carbon bonds shown so each example in this question is an alkane or a branched alkane.

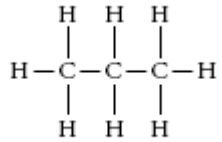
a) There are 7 carbon atoms and 16 hydrogen atoms. The name of the compound is heptane.

b) The longest chain has 5 carbons and the compound will be a derivative of pentane. There are two methyl groups (CH_3–): one on carbon C2 and one on carbon C3. The name of the compound is 2,3-dimethylpentane.
c) The longest chain has 6 carbon atoms and the compound will be a derivative of hexane. On carbon C4 there is an ethyl group (C_2H_5–). There are two methyl groups (CH_3–): one on carbon C2 and one on carbon C3. The name of the compound is 4-ethyl-2,3-dimethylhexane.

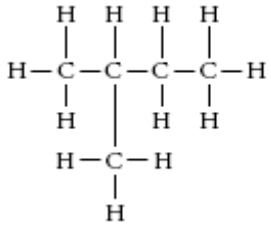
Check Your Solution
Checking the number of carbons and the location of the branches verifies that the longest chain is correct and the branches are on the lowest numbered carbon atom in each case.

4.
Problem
Draw a structural formula for each of the following organic molecules:
a) propane
b) 2-methylbutane

Solution
a) The root is –prop, so there are three carbon atoms in the main chain. The suffix is –ane so the compound is an alkane. There are no branches. The structural diagram is

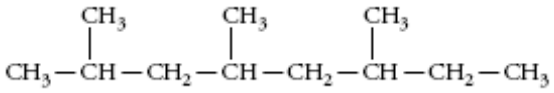


b) The root is –but, so there are four carbon atoms in the main chain. The suffix is –ane so the compound is a branched alkane. The prefix is 2-methyl so there is a methyl group on carbon C2. The structural diagram is

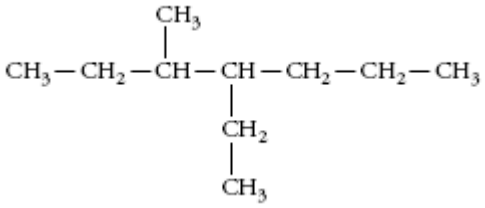


5.
Problem
Draw a condensed structural formula for each of the following:
a) 2,4,6- trimethyloctane
b) 4-ethyl-3-methylheptane

Solution
a) The root is –oct so there are eight carbon atoms in the main chain. The suffix is –ane so compound is a branched alkane. The prefix is 2,4,6-trimethyl so there are methyl groups (CH_3–) on carbons C2, C4, and C6. The condensed structural formula is



b) The root is –hept so there are seven carbon atoms in the main chain. The suffix is –ane so compound is a branched alkane. The prefix is 4-ethyl-3-methyl so there is an ethyl group (C_2H_5–) on carbon C4 and a methyl group (CH_3–) on carbon C3. The condensed structural formula is



6.

Problem

For each of the molecules listed in question 5, draw an expanded molecular formula.

Solution

An expanded molecular formula shows groupings of atoms without drawing lines for bonds. Brackets are used to indicate locations of branched chains.

a) $CH_3CH(CH_3)CH_2CH(CH_3)CH_2CH(CH_3)CH_2CH_3$

b) $CH_3CH_2CH(CH_3)CH(C_2H_5)CH_2CH_2CH_3$

7.

Problem

The following names are *incorrect*. Draw structures that these names describe. Examine your drawing, and rename the hydrocarbon correctly.

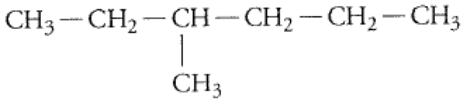
a) 3-propylbutane

b) 1,3-dimethylhexane

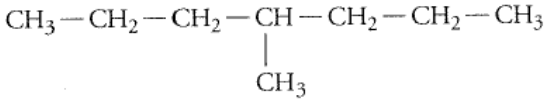
c) 4-methylpentane

Solution

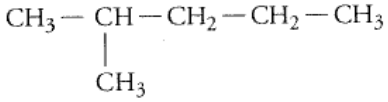
a) The propyl group (C_3H_7–) should be part of the main chain. The correct name is 3-methylhexane.



b) The first methyl group should be part of the main chain. The remaining methyl group (CH_3–) is now on carbon C4. The correct name is 4-methylheptane.



c) Number the main chain in the opposite direction to give a lower position number for the methyl group (CH_3–). The correct name is 2-methylpentane.



8.

Problem

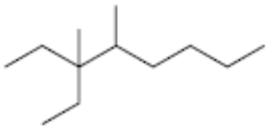
Draw a line structural formula for each of the following alkanes:

a) 3-ethyl-3,4-dimethyloctane
b) 2,3,4-trimethylhexane
c) 5-ethyl-3,3-dimethylheptane
d) 4-butyl-6-ethyl-2,5-dimethylnonane

Solution

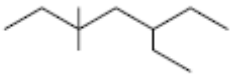
In a line structural diagram, the end of the line and the points at which lines meet represent a carbon atom. Sufficient hydrogen atoms are assumed to be around each carbon atom to fulfill the valence requirements for carbon.

a) The root is –oct so there are 8 carbons in the main chain. The suffix is –ane so the compound is a branched alkane. The prefix is 3-ethyl-3,4-dimethyl so there is an ethyl group (C_2H_5–) on carbon C3 and methyl groups (CH_3–) on carbons C3 and C4.

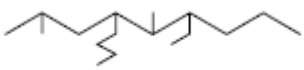


b) The root is –hex so there are 6 carbons in the main chain. The suffix is –ane so the compound is a branched alkane. The prefix is 2,3,4-trimethyl so there are methyl groups (CH_3–) on carbons C2, C3 and C4.

c) The root is –hept so there are 7 carbons in the main chain. The suffix is –ane so the compound is a branched alkane. The prefix is 5-ethyl-3,3-dimethyl so there is an ethyl group (C_2H_5–) on carbon C5 and two methyl groups (CH_3–) on carbon C3.

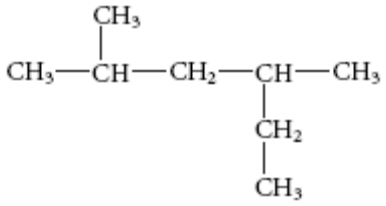


d) The root –non so there are 9 carbons in the main chain. The suffix is –ane so the compound is a branched alkane. The prefix is 4-butyl-6-ethyl-2,5-dimethyl so there is a butyl group (C_4H_9–) on carbon C4, an ethyl group (C_2H_5–) on carbon C6 and methyl groups (CH_3–) on carbons C2 and C5.

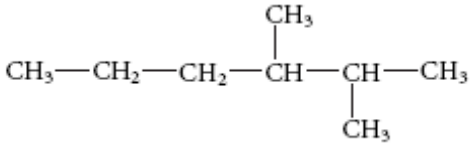


Check Your Solution
Check that the number of carbons in the longest chain matches the root of the name and that the alkyl groups are attached to the proper numbered carbon atom.

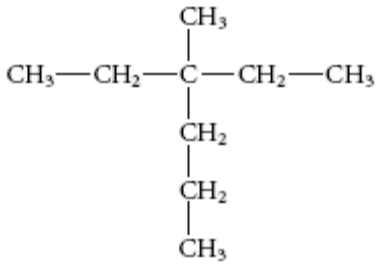
9.
Problem
Examine the following compounds and their names. Identify any mistakes, and correct the names as necessary.
a) 4-ethyl-2-methylpentane



b) 4,5-methylhexane



c) 3-methyl-3-ethylpentane



What is Required?
You must verify if the names for the given condensed structural diagrams are correct.

What is Given?
The condensed structural diagram is given with a chemical name.

Plan Your Strategy
For each diagram, follow the rules for naming alkanes.
Step 1 Find the root: Identify the longest continuous main chain and count the number of carbon atoms in this chain. Use the appropriate numerical prefix to indicate the number of carbon atoms in the longest main chain.

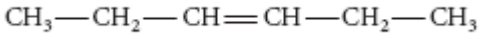
Step 2 Find the suffix: Each compound is a branched alkane. The suffix for each compound will be –ane.
Step 3 Assign a position number: Identify all branches present. Number the longest continuous chain starting from the end that gives the lowest number to the first location at which branching occurs.
Step 4 Find the prefix:

- Number the branch by the number of main chain C to which it is attached. The branches are alkyl groups that are named by changing the –ane ending of the corresponding alkane to –yl.
- If more than one of the same type of branch alkane is present, name them using the appropriate number prefixes (*di*– for two, *tri*– for 3, *tetra*– for 4 etc.)
- If more than one type of branch is present, write the names of these sides groups in alphabetical order. Do not include the name of the prefix that shows the number of that type of branch.
- Use hyphens to separate words from numbers.
- Use commas to separate numbers.

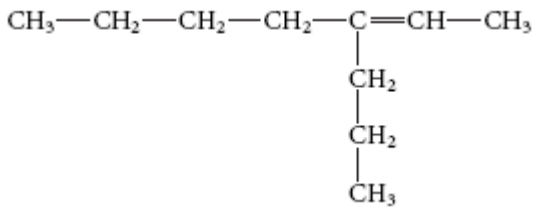
Act on Your Strategy
a) The longest continuous chain has 6 carbons, not 5, with two methyl groups (CH_3–) on carbons C2 and C4. The correct name is 2,4-dimethylhexane.
b) The longest continuous chain of 6 carbons should be numbered from right to left. The correct name is 2,3-dimethylhexane.
c) The longest continuous chain has 6 carbons, not 5, with an ethyl group (C_2H_5–) and a methyl group (CH_3–) on carbon C3. The correct name is 3-ethyl-3-methylhexane.

Check Your Solution
Check that the number of carbons in the longest chain matches the root of the name and that the alkyl groups are attached to the proper numbered carbon atom.

10.
Problem
Name each alkene:
a)



b)



What is Required?
You must name each compound.

What is Given?
A condensed structural diagram is given for each compound.

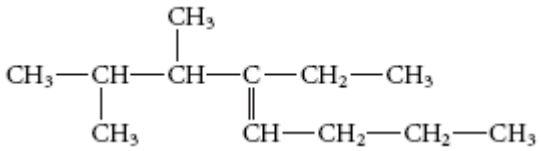
Plan Your Strategy
Step 1 Find the root: Identify the longest continuous chain that contains the double bond and count the number of carbon atoms in this chain. Use the appropriate numerical prefix to indicate the number of carbon atoms in the longest main chain.
Step 2 Find the suffix: The suffix for molecules with a double bond is –ene.
Step 3 Assign a position number: The main chain is numbered from the end that is closer to the double bond. The position of the double bond is designated by the number of the first carbon involved in that bond.
Step 4 Find the prefix: Identify all branches present. The prefix is named according to the same rules that apply to alkanes.
Step 5 Name the compound: The name for the compound is made up as: prefix + root + suffix

Act on Your Strategy
a) Step 1 Find the root: The longest chain that contains the double bond has six carbon atoms. The root is –hex.
Step 2 Find the suffix: There is a double bond, so the suffix is –ene. Together with the root, this molecule is a –hexene.
Step 3 Assign position numbers: The chain can be numbered from either end in this case. The double bond is between carbons C3 and C4 regardless of which end the numbering begins. The molecule is a –hex-3-ene.
Step 4 Since there are no branches on the chain, the name of this molecule is hex-3-ene.

b) Step 1 Find the root: The longest chain that contains the double bond has 7 carbon atoms. The root is –hept.
Step 2 Find the suffix: There is a double bond, so the suffix is –ene. Together with the root, this molecule is a –heptene.
Step 3 Assign position numbers: Number the main chain from the right to give the lowest position number for the double bond. The double bond is between carbons C2 and C3. The molecule is a –hept-2-ene.
Step 4 Find the prefix: A propyl group (C_3H_7–) is attached to carbon C3. The prefix is 3-propyl-.
Step 5: The name of this molecule is 3-propylhept-2-ene.

Check Your Solution
Check that the number of carbons in the longest chain matches the root name, that the double bond has the lowest possible number, and that the alkyl groups are attached to the proper numbered carbon atom in the longest chain.

11.
Problem
Name this alkene:



What is Required?
You must name the compound.

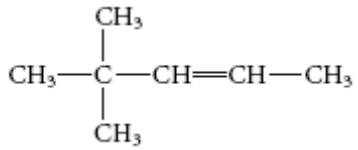
What is Given?
A condensed structural diagram is given for the compound.

Plan Your Strategy
Step 1 Find the root: Identify the longest continuous chain that contains the double bond and count the number of carbon atoms in this chain. Use the appropriate numerical prefix to indicate the number of carbon atoms in the longest main chain.
Step 2 Find the suffix: The suffix for molecules with a double bond is –ene.
Step 3 Assign position numbers: The main chain is numbered from the end that is closer to the double bond. The position of the double bond is designated by the number of the first carbon involved in that bond.
Step 4 Find the prefix: Identify all branches present. The prefix is named according to the same rules that apply to alkanes.
Step 5 Name the compound: The name for the compound is made up as: prefix + root + suffix

Act on Your Strategy
Step 1 Find the root: The longest chain that contains the double bond has eight carbon atoms. The root is –oct.
Step 2 Find the suffix: There is a double bond, so the suffix is –ene. Together with the root, this molecule is –octene.
Step 3 Assign position numbers: The double bond is between carbons C4 and C5 regardless of which way the main chain is numbered. However, the next priority is to have the branches on the lowest numbered carbons. Therefore the main chain should be numbered from left to right. The molecule is a –oct-4-ene.
Step 4 Find the prefix: An ethyl group (C_2H_5–) is attached to carbon C4. Methyl groups (CH_3–) are attached to carbons C2 and C3. The prefix is 4-ethyl-3,4-dimethyl-.
Step 5: The name of this molecule is 4-ethyl-2,3-dimethyloct-4-ene.

Check Your Solution
Check that the number of carbons in the longest chain matches the root name, that the double bond has the lowest possible number, and that the alkyl groups are attached to the proper numbered carbon atom in the longest chain.

12.
Problem
Name the following alkene:



What is Required?
You must name the compound.

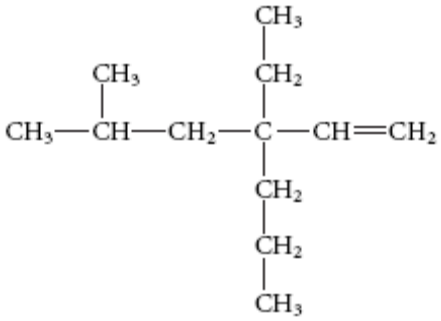
What is Given?
A condensed structural formula is given for the compound.

Plan Your Strategy
Step 1 Find the root: Identify the longest continuous chain that contains the double bond and count the number of carbon atoms in this chain. Use the appropriate numerical prefix to indicate the number of carbon atoms in the longest main chain.
Step 2 Find the suffix: The suffix for molecules with a double bond is –ene.
Step 3 Assign position numbers: The main chain is numbered from the end that is closer to the double bond. The position of the double bond is designated by the number of the first carbon involved in that bond.
Step 4 Find the prefix: Identify all branches present. The prefix is named according to the same rules that apply to alkanes.
Step 5 Name the compound: The name for the compound is made up as: prefix + root + suffix

Act on Your Strategy
Step 1 Find the root: The longest chain that contains the double bond has five carbon atoms. The root is –pent.
Step 2 Find the suffix: There is a double bond, so the suffix is –ene. Together with the root, this molecule is –pentene.
Step 3 Assign position numbers: Number the main chain from the right to give the lowest position number for the double bond. The double bond is between carbons C2 and C3. The molecule is a –pent-2-ene.
Step 4 Find the prefix: There are two methyl groups ($–CH_3$) attached to carbon C4. The prefix is 4,4-dimethyl.
Step 5: The name of this molecule is 4,4-dimethylpent-2-ene.

Check Your Solution
Check that the number of carbons in the longest chain matches the root name, that the double bond has the lowest possible number, and that the alkyl groups are attached to the proper numbered carbon atom in the longest chain.

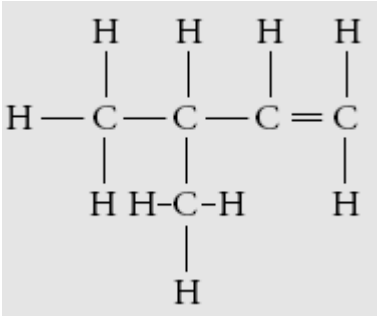
13.
Problem
A classmate claims that the following alkene is named 3-methyl-4-ethyl-4-propyl-hex-5-ene. Do you agree? If not, give the correct name.



Solution
Step 1 Find the root: The longest chain that contains the double bond has six carbon atoms. The root is -hex-.
Step 2 Find the suffix: The molecule has a double bond so the suffix ends with –ene.
Step 3 Assign position numbers: Numbering must begin at the right end of the molecule because it is closest to the double bond. The position of the double bond is 1 so the suffix is -1-ene.
Step 4 Find the prefix: There is one methyl group on carbon atom number 5, one ethyl group on carbon number 3, and one propyl group on carbon atom number 3. The prefix is 3-propyl-3-ethyl-5-methyl-.
Step 5 The full name of the compound is 3-ethyl-3-methyl-3-propylhex-1-ene.

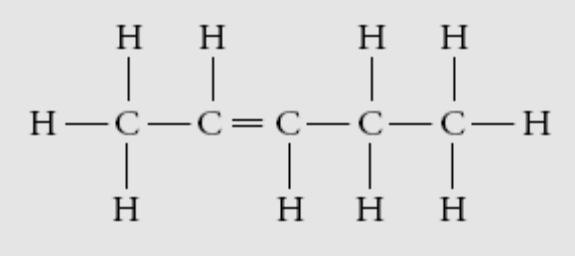
14.
Problem
Draw structural formulas for each compound:
a) 3-methylbut-1-ene
b) pent-2-ene
c) 4,4-dimethylpent-1-ene

Solution
a) Step 1 The root is –but so there are four carbon atoms in the main chain.
Step 2 The suffix is -1-ene so it has a double bond after carbon atom number one.
Step 3 The prefix is 3-methyl- so there is one methyl group ($–CH_3$) on the third carbon atom.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of 3-methylbut-1-ene is:

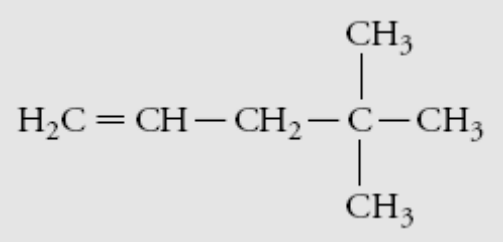


b) Step 1 The root is –pent so there are five carbon atoms in the main chain.

Step 2 The suffix is –2-ene so it has a double bond after carbon atom number two.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of pent-2-ene is:

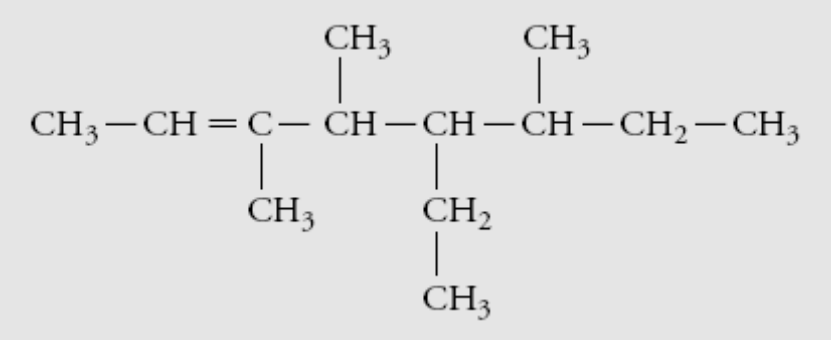


c) Step 1 The root is –pent so there are five carbon atoms in the main chain.
Step 2 The suffix is -1-ene so it has a double bond after carbon atom number one.
Step 3 The prefix is 4,4-dimethyl- so there are two methyl groups ($-CH_3$) on carbon C4.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of 4,4-dimethylpent-1-ene is:

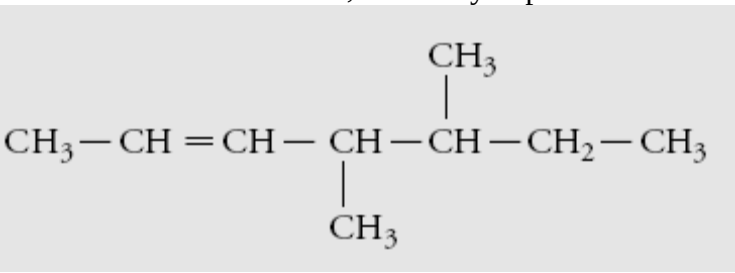


15.
Problem
Draw condensed structural formulas for each compound:
a) 5-ethyl-3,4,6-trimethyloct-2-ene
b) 4,5-dimethylhept-2-ene
c) 3-ethyl-4-methylhex-1-ene
d) 2,5,7-trimethyloct-3-ene

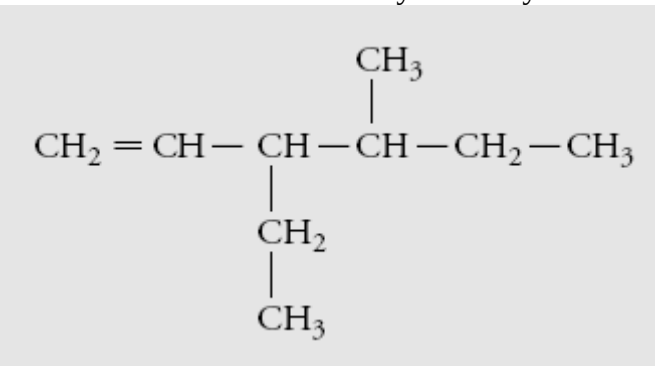
Solution
a) Step 1 The root is –oct so there are eight carbon atoms in the main chain.
Step 2 The suffix is -2-ene so it has a double bond after carbon atom number two.
Step 3 The prefix is 5-ethyl-3,4,6-trimethyl so there is one $-CH_2CH_3$ group on the fifth carbon atom. There is one $-CH_3$ on the third carbon atom, one on the fourth carbon atom, and one on the sixth carbon atom.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of 5-ethyl-3,4,6-trimethyloct-2-ene is:



b) Step 1 The root is –hept so there are seven carbon atoms in the main chain.
Step 2 The suffix is -2-ene so it has a double bond after carbon atom number two.
Step 3 The prefix is 4,5-dimethyl- so there is one methyl group ($–CH_3$) on the fourth carbon atom and one on the fifth carbon atom.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of 4,5-dimethylhept-2-ene is:

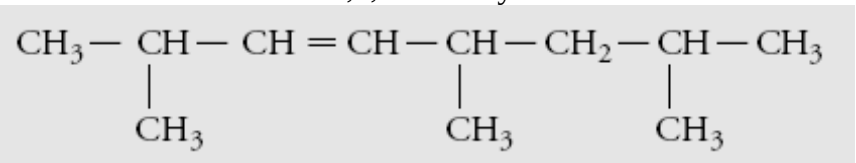


c) Step 1 The root is –hex so there are six carbon atoms in the main chain.
Step 2 The suffix is -1-ene so it has a double bond after carbon atom number one.
Step 3 The prefix is 3-ethyl-4-methyl- so there is one $–CH_2CH_3$ group on the third carbon atom. There is one $–CH_3$ on the fourth carbon atom.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of 3-ethyl-4-methylhex-1-ene is:

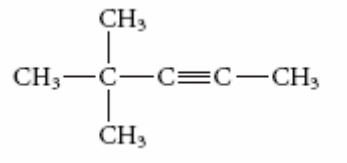


d) Step 1 The root is –oct so there are eight carbon atoms in the main chain.
Step 2 The suffix is -3-ene so it has a double bond after carbon atom number three.

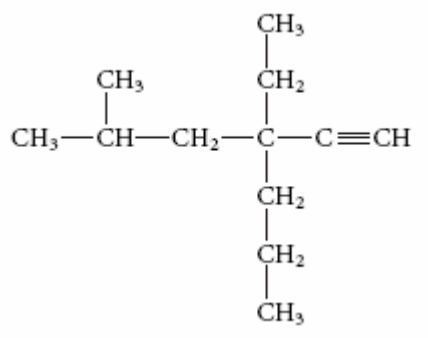
Step 3 The prefix is 2,5,7-trimethyl- so there is one $–CH_3$ group on the second carbon atom, one on the fifth carbon atom, and one on the seventh carbon atom.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.
The structural formula of 2,5,7-trimethyloct-3-ene is:



16.
Problem
Name the following alkynes.
a)



b)



Solution
a) Step 1 There are five carbon atoms in the main chain so the root is –pent.
Step 2 The triple bond comes after carbon atom number two so the suffix is -2-yne.
Step 3 There are two $–CH_3$ groups on the fourth carbon atom so the prefix is 4,4-dimethyl-.
Step 4 The name is 4,4-dimethylpent-2-yne.

b) Step 1 There are six carbon atoms in the main chain so the root is –hex-.
Step 2 The triple bond comes after carbon atom number one so the suffix is –1-yne.
Step 3 There is one $–CH_3$ group on the fifth carbon atom, one $–CH_2CH_3$ group on the third carbon atom, and one $–CH_2CH_2CH_3$ group on the third carbon atom so the prefix is 3-ethyl-5-methyl-3-propyl-.
Step 4 The name is 3-ethyl-5-methyl-3-propylhex-1-yne.

17.
Problem

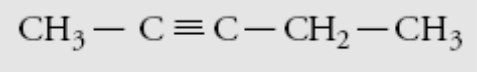
Draw a condensed structural formula for each of the following compounds.
a) pent-2-yne
b) 4,5-dimethylhept-2-yne
c) 3-ethyl-4-methylhex-1-yne
d) 2,5,7-trimethyloct-3-yne

What is Required?
You must draw the condensed structural diagram of the given alkynes.

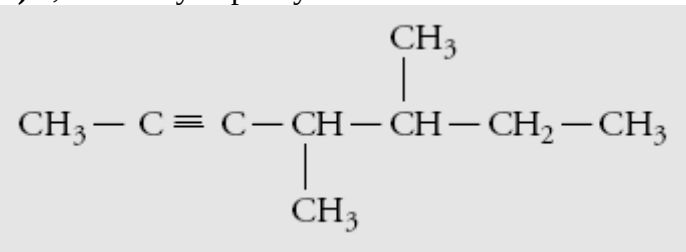
What is Given?
The names of the branched alkynes are given.

Plan Your Strategy
A condensed structural diagram shows the bonds between the carbon atoms but not the bonds between the carbon and hydrogen atoms.
Step 1 Identify the root in the name and the number of carbons in the longest continuous chain.
Step 2 Draw the main chain of C atoms. The number before the root name indicates the position of the triple bond. Number the rest of the main chain so that the triple bond has the lowest possible position number.
Step 3 Add the branches to the main chain. The number in front of the alkyl branch identifies the main chain C to which it is attached. Add sufficient H atoms to each carbon in the main chain so that each carbon has 4 bonds.

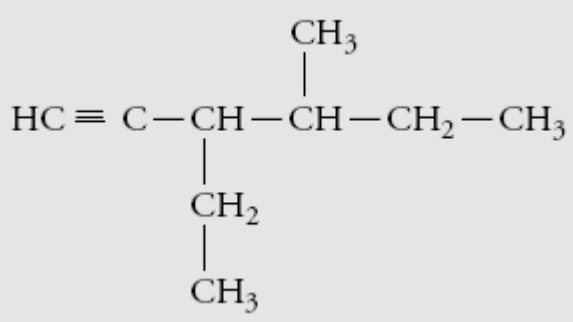
Act on Your Strategy
a) pent-2-yne



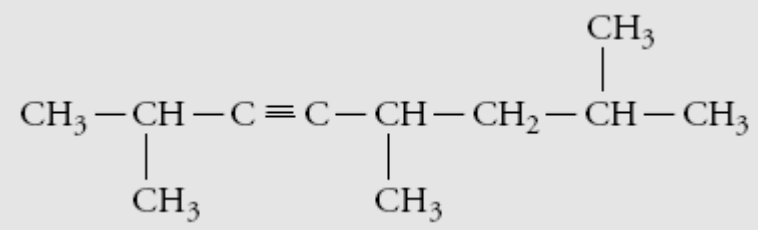
b) 4,5-dimethylhept-2-yne



c) 3-ethyl-4-methylhex-1-yne

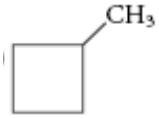


d) 2,5,7-trimethyloct-3-yne

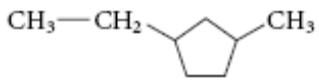


Check Your Solutions
Check that the number of carbons in the longest chain matches the root name, that the triple bond has the lowest possible number, and that the alkyl groups are attached to the proper numbered carbon atom in the longest chain.

18.
Problem
Name each of the following cyclic hydrocarbons:
a)



b)



What is Required?
You must name each compound.

What is Given?
The condensed structural diagram for each cycloalkane is given.

Plan Your Strategy
Apply the following rules to name the cyclic alkanes.
Step 1 Find the root: Count the number of carbon atoms in the ring and use the appropriate prefix to indicate this number of carbon atoms in the root name. The prefix cyclo– indicates a ring structure.
Step 2 Find the suffix: Use the suffix for an alkane –ane.
Step 3 Assign position numbers: The branches begin at carbon C1 and proceed either clockwise or counterclockwise to have the lowest possible number in the ring.
Step 4 Find the prefix: Identify all branches and list them alphabetically.
Step 5 Name the Compound: The name of the compound is made up as: prefix + root + suffix

Act on Your Strategy

a) The ring has 4 C atoms so it is a cyclobutane. There is only a methyl group on the ring so this will be position C1. The name is of the compound 1-methylcyclobutane or simply methylcyclobutane.
b) The ring has 5 C atoms so it is a cyclopentane. There is an ethyl group ($CH_3–CH_2–$) and a methyl group ($CH_3–$) attached to the ring. The ethyl group is attached to carbon C1. The methyl group is clockwise to the ethyl group and is on carbon C3. The name of the compound is 1-ethyl-3-methylcyclopentane.

Check Your Solution
Check that the ring has the correct number of carbons and that the alkyl groups are attached to the lowest numbered carbon.

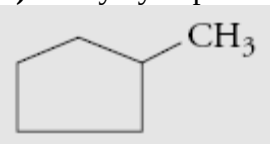
19.
Problem
Draw a condensed structural diagram for each compound:
a) methylcyclopentane
b) 1,2-dimethylcyclobutane

What is Required?
You must draw a condensed structural diagram for each molecule.

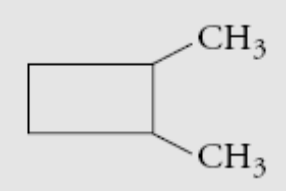
What is Given?
The name is given for each compound.

Plan Your Strategy
Step 1 Identify the number of carbons in the ring from the prefix used with the root.
Step 2 Number the chain clockwise or counterclockwise so that the attached groups can be positioned at the lowest possible numbered carbon.
Step 3 Attach the alkyl groups listed in the prefix to the chain.

Act on Your Strategy
a) methylcyclopentane



b) 1,2-dimethylcyclobutane



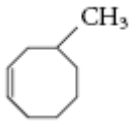
Check Your Solution
Check that the ring has the correct number of carbons and that the alkyl groups are attached to the lowest numbered carbon.

20.

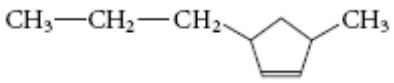
Problem

Name each of the following cyclic hydrocarbons:

a)



b)



What is Required?

You must name each compound.

What is Given?

The condensed structural diagram for each branched cycloalkene is given.

Plan Your Strategy

Apply the following rules to name the cyclic alkenes.

Step 1 Find the root: Count the number of carbon atoms in the ring and use the appropriate prefix to indicate this number of carbon atoms in the root name. The prefix cyclo– indicates a ring structure.

Step 2 Find the suffix: The suffix to indicate the presence of a double bond is –ene.

Step 3 Assign position numbers: The double bond in the ring must be between carbons C1 and C2. Number the ring either clockwise or counterclockwise to the nearest branch starting at carbon C1.

Step 4 Find the prefix: Identify all branches and list them alphabetically.

Step 5 Name the Compound: The name of the compound is made up as: prefix + root + suffix

Act on Your Strategy

a) The ring has 8 carbons with a double bond, so it is a cyclooctene. A methyl group (CH_3–) is on the ring. Count clockwise from carbon C1 to the methyl group (CH_3–) at carbon C4. The name of the compound is 4-methylcyclooctene.

b) The ring has 5 carbons with a double bond, so it is a cyclopentene. There is a propyl group (CH_3–CH_2–CH_2–) and a methyl group (CH_3–) on the ring. Counting counterclockwise from C1, the methyl group is on carbon C3 and the propyl group is on carbon C5. The name of the compound is 3-methyl-5-propylcyclopentene.

Check Your Solution

Check that the ring has the correct number of carbons, that the double bond is at C1 and that the alkyl groups are attached to the lowest numbered carbon.

21.

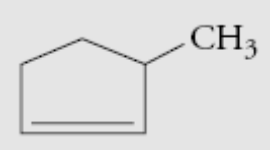
Problem
Draw a condensed structural formula for each compound:
a) 3-methylcyclopentene
b) 2-ethyl-3-propylcyclobutene

What is Required?
You must draw a condensed structural diagram for each molecule.

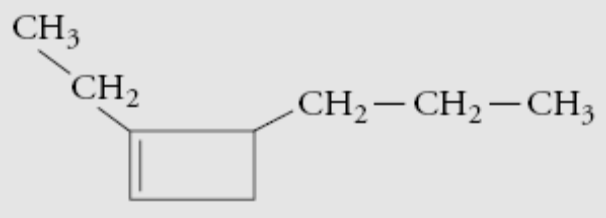
What is Given?
The name is given for each compound.

Plan Your Strategy
Step 1 Identify the number of carbons in the ring from the prefix used with the root.
Step 2 The suffix –ene indicates that a double bond is present in the ring**.** The chain will be numbered so that the double bond is between carbons C1 and C2.
Step 3 Count clockwise or counterclockwise so that the attached groups can be positioned at the lowest possible numbered carbon.
Step 4 Attach the alkyl groups listed in the prefix to the chain.

Act on Your Strategy
a) 3-methylcyclopentene

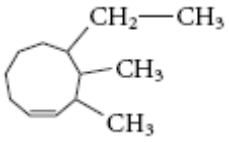


b) 2-ethyl-3-propylcyclobutene

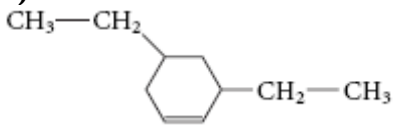


Check Your Solution
Check that the ring has the correct number of carbons, that the double bond is between carbons C1 and C2 and that the alkyl groups are attached to the lowest numbered carbon.

22.
Problem
Name each of the following cyclic hydrocarbons:
a)



b)



What is Required?
You must name each compound.

What is Given?
The condensed structural diagram for each branched cycloalkene is given.

Plan Your Strategy
Apply the following rules to name the branched cyclic alkenes.
Step 1 Find the root: Count the number of carbon atoms in the ring and use the appropriate prefix to indicate this number of carbon atoms in the root name. The prefix cyclo– indicates a ring structure.
Step 2 Find the suffix: The suffix to indicate the presence of a double bond is –ene.
Step 3 Assign position numbers: The double bond in the ring must be between carbons C1 and C2. Number the ring either clockwise or counterclockwise to the nearest branch starting at carbon C1.
Step 4 Find the prefix: Identify all branches and list them alphabetically.
Step 5 Name the compound: The name of the compound is made up as: prefix + root + suffix

Act on Your Strategy
a) The ring has 9 carbons with a double bond, so it is a cyclononene. Two methyl groups (CH_3–) are attached to the ring and one ethyl group (–CH_2CH_3). Count counterclockwise from C1 to the methyl groups (CH_3–) at C3 and C4, and the ethyl group (–CH_2CH_3) at C5. The name of the compound is 5-ethyl-3,4-dimethylnonene.
b) The ring has 6 carbons with a double bond, so it is a cyclohexene. There are two ethyl groups (CH_3–CH_2–) on the ring. Counting counterclockwise from C1, the ethyl groups are on carbons C3 and C5. The name of the compound is 3,5-diethylcyclohexene.

Check Your Solution
Check that the ring has the correct number of carbons, that the double bond is between carbons C1 and C2 and that the alkyl groups are attached to the lowest numbered carbon.

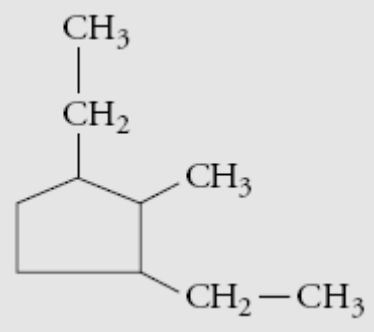
23.
Problem
Draw a condensed structural formula for each compound:
a) 1,3-diethyl-2-methylcyclopentane
b) 4-butyl-1,3-dimethylcyclohexane

What is Required?
You must draw a condensed structural diagram for each molecule.

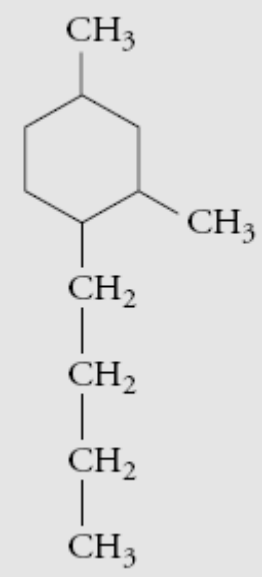
What is Given?
The name is given for each compound.

Plan Your Strategy
Step 1 Identify the number of carbons in the ring from the prefix used with the root.
Step 2 Number the chain clockwise or counterclockwise so that the attached groups can be positioned at the lowest possible numbered carbon.
Step 3 Attach the alkyl groups listed in the prefix to the chain.

Act on Your Strategy
a) 1,3-diethyl-2-methylcyclopentane

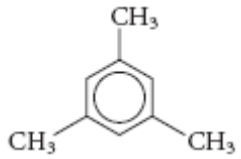


b) 4-butyl-1,3-dimethylcyclohexane



Check Your Solution
Check that the ring has the correct number of carbons and that the alkyl groups are attached to the lowest numbered carbon.

24.
Problem
Name the following aromatic compound:



What is Required?
You must name the given compound.

What is Given?
The condensed structural diagram is given**.**

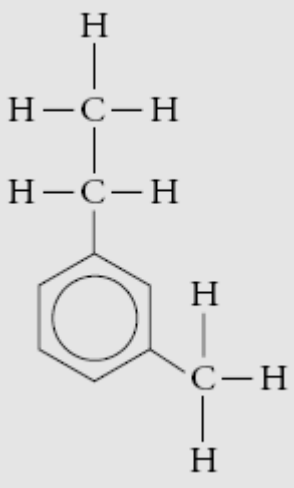
Plan Your Strategy
Apply the following rules to name an aromatic compound.
Step 1 Find the root: The root name is benzene.
Step 2 Assign position numbers: Number the carbons either clockwise or counterclockwise in the benzene ring. If more than one type of branch is attached to the ring, start numbering at the carbon with the highest priority group.
Step 3 Find the prefix: Name any branches that are attached to the benzene ring and their position numbers.
Step 4 Name the compound: The name for the compound is made up as: prefix + root

Act on Your Strategy
Step 1 Start numbering at one of the branches. Since they are identical and spaced evenly, it doesn't matter which one.
Step 2 There are methyl groups at carbons 1, 3, and 5.
Step 3 The name is 1,3,5-trimethylbenzene.

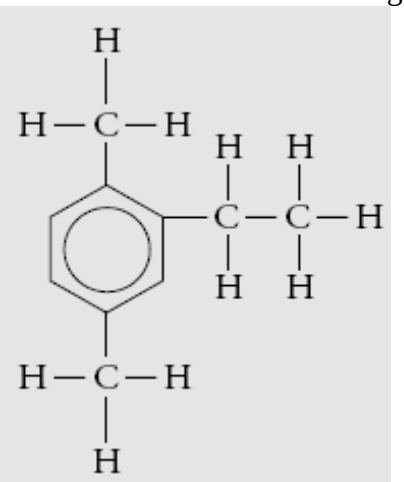
Check Your Solution
Check that the root of the name is benzene and the attached groups have the lowest number position.

25.
Problem
Draw a structural diagram for each aromatic compound given:
a) 1-ethyl-3-methylbenzene
b) 2-ethyl-1,4-dimethylbenzene

Solution
a) 1-ethyl-3-methylbenzene
An ethyl group (C_2H_5–) is attached at carbon C1 and a methyl group (CH_3–) is attached to carbon C3 on a benzene ring.



b) 2-ethyl-1,4-dimethylbenzene
Methyl groups (CH_3–) are attached to carbons C1 and C4 and an ethyl group (C_2H_5–) is attached to carbon C2 of a benzene ring.



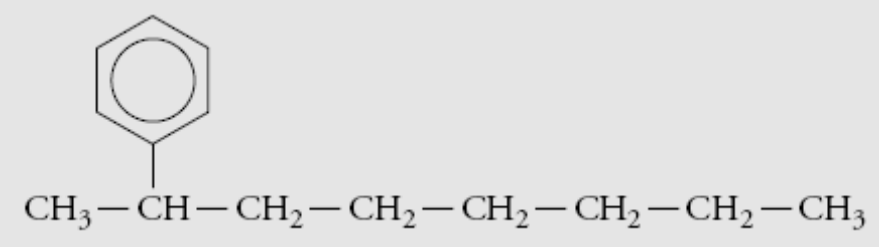
26.
Problem
Draw a structural diagram for 2-phenylbutane.

What is Required?
You must name the given compound.

What is Given?
The name of the compound is given.

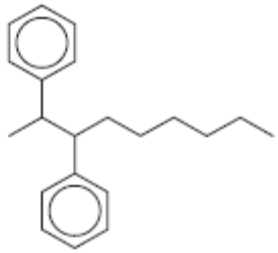
Plan Your Strategy
When a benzene ring is attached to relatively large hydrocarbon chain, it is treated as the substituted group. The attached benzene ring is called a phenyl group, C_6H_5–.
Butane is an alkane having a chain of 4 carbons. Use the prefix to position the phenyl group on the butane chain.

Act on Your strategy



Check your Solution
The molecule has a main chain of 4 carbon atoms with a phenyl group attached at carbon C2.

27.
Problem
Name the following aromatic compound:



What is Required?
You must name the given compound.

What is Given?
The name of the compound is given.

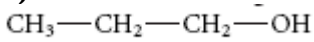
Plan Your Strategy
In a line structural diagram, the end of the line and the points at which the lines meet, represent carbon atoms. Hydrogen atoms are not shown but are assumed to be present to account for the remainder of the bonds around each carbon atom.

Act on Your Strategy
The main chain has 9 carbons. Only single bonds are found between the carbon atoms so the compound is a derivative of an alkane. The root is nonane. Phenyl groups are attached at carbons C2 and C3. The name of this compound is 2,3-diphenylnonane.

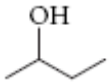
Check on Your Solution
Check to see that the number of carbons in the chain corresponds to the prefix and that the phenyl groups are attached to the correct carbon atoms.

28.
Problem
Name each of the following alcohols.

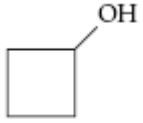
a)



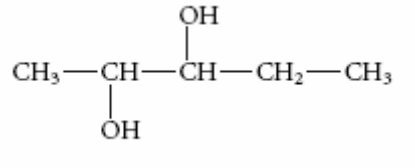
b)



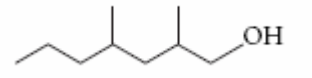
c)



d)



e)



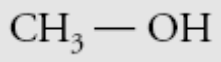
Solution

a) Step 1 There are three carbon atoms in the main chain so the root is -*propane*-.
Step 2 The hydroxide group is attached to carbon atom number one so the suffix is -1-*ol*.
Step 3 The name is propan-1-ol.
b) Step 1 There are four carbon atoms in the main chain so the root is -*butane*-.
Step 2 The hydroxide group is attached to carbon atom number two so the suffix is -2-*ol*.
Step 3 The name is butan-2-ol.
c) Step 1 There are four carbon atoms in a continuous chain so the root is -*cyclobutane*-.
Step 2 The hydroxide group is attached to carbon atom number one so the suffix is -1-*ol*.
Step 3 The name is cyclobutanol.
d) Step 1 There are five carbon atoms in the main chain so the root is -*pentane*-.
Step 2 There is one hydroxide group attached to carbon atom number two and one hydroxide group attached to carbon atom number three so the prefix is 2,3- and the suffix is -*diol*.
Step 3 The name is pentane-2,3-diol.
e) Step 1 There are seven carbon atoms in the main chain so the root is -*heptane*-.
Step 2 There is one hydroxide group attached to carbon atom number one so the suffix is -1-*ol*.
Step 3 There is one $-CH_3$ group attached to carbon atom number two and one attached to carbon atom number four so the prefix is 2,4-*dimethyl*-.
Step 4 The name is 2,4-dimethylheptan-1-ol.

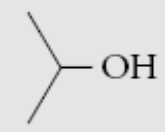
29.
Problem

Draw each of the following alcohols:
a) methanol
b) propan-2-ol
c) butane-2,2-diol
d) 3-ethyl-4-methyloctan-1-ol
e) 2,4-dimethylcyclopentanol

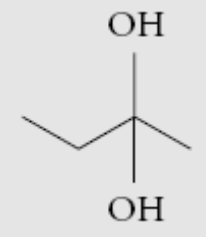
Solution
a) Step 1 The root is *methane*- so there is one carbon atom in the main chain.
Step 2 The suffix is -*ol* so it has a hydroxide group attached to carbon atom number one.
Step 3 The carbon atom must be bonded to enough hydrogen atoms to give it exactly four bonds.



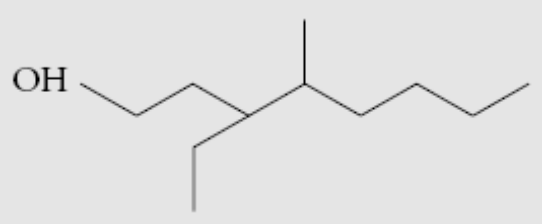
b) Step 1 The root is *propane*- so there are three carbon atoms in the main chain.
Step 2 The suffix is -2-*ol* so it has a hydroxide group attached to carbon atom number two.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.



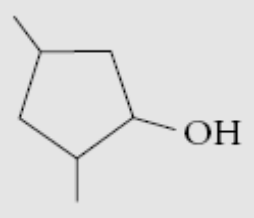
c) Step 1 The root is *butane*- so there are four carbon atoms in the main chain.
Step 2 The suffix is -2,2-*diol* so it has two hydroxide groups attached to carbon atom number two.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.



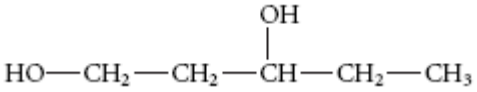
d) Step 1 The root is *octane*- so there are eight carbon atoms in the main chain.
Step 2 The suffix is -1-*ol* so it has a hydroxide group attached to carbon atom number one.
Step 2 The prefix is -3-*ethyl*-4-*methyl*- so it has one $–CH_2CH_3$ group attached to carbon atom number three and one $–CH_3$ group attached to carbon atom number four.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.



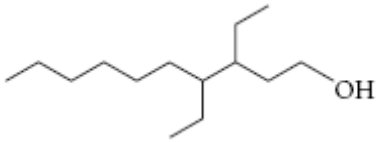
e) Step 1 The root is *cyclopentane-* so there are five carbon atoms in a continuous chain.
Step 2 The suffix is *-ol* so it has one hydroxide group attached to carbon atom number one.
Step 2 The prefix is -2,4-*dimethyl-* so it has one $–CH_3$ group attached to carbon atom number two and one $–CH_3$ group attached to carbon atom number four.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.



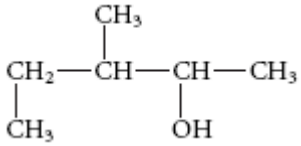
30.
Problem
Identify any errors in each name. Give the correct name for the alcohol:
a) heptan-1,3-ol



b) 3-ethyl-4-ethyldecan-1-ol



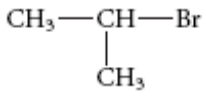
c) 1,2-dimethylbutan-3-ol



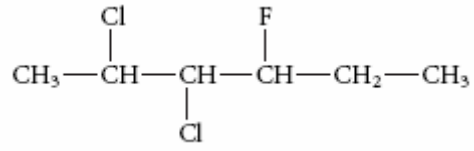
Solution
a) Step 1 There are five carbon atoms in the main chain so the root is *-pentane-*.
Step 2 There is one hydroxide group attached to carbon atom number one and one hydroxide group attached to carbon atom number three so the prefix is 1,3-.
Step 3 There are two hydroxide groups so the suffix is *-diol*.
Step 4 The name is pentane-2,3-diol.
b) Step 1 There are ten carbon atoms in the main chain so the root is *-decane-*.

Step 2 There is one hydroxide group attached to carbon atom number one so the suffix is -1-*ol*.
Step 3 There is one $-CH_2CH_3$ group attached to carbon atom number three and one $-CH_2CH_3$ group attached to carbon atom number four so the prefix is 3,4-*diethyl*-.
Step 4 The name is 3,4-diethyldecan-1-ol.
c) Step 1 There are five carbon atoms in the main chain so the root is -*pentane*-.
Step 2 There is one hydroxide group attached to carbon atom number two so the suffix is -2-*ol*.
Step 3 There is one $-CH_3$ group attached to carbon atom number three so the prefix is 3-*methyl*-.
Step 4 The name is 3-methylpentan-2-ol.

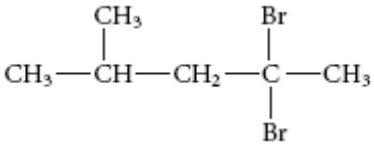
31.
Problem
Name the following alkyl halides.
a)



b)



c)



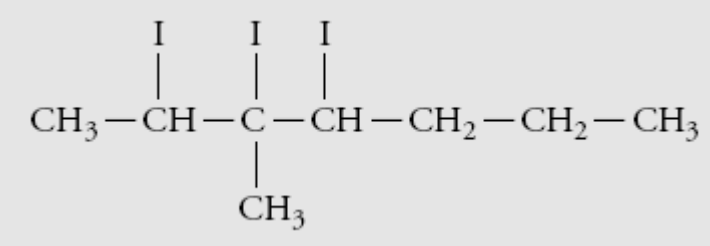
Solution
a) Step 1 There are three carbon atoms in the main chain so the root is -*propane*-.
Step 2 There is one bromine attached to carbon atom number two so the prefix is 2-*bromo*.
Step 3 The name is 2-bromopropane.
b) Step 1 There are six carbon atoms in the main chain so the root is -*hexane*-.
Step 2 There is one fluorine attached to carbon atom number four. There is one chlorine attached to carbon atom number two and one chlorine attached to carbon atom number three. The prefix is 2,3-*dichloro*-4-*fluoro*-.
Step 3 The name is 2,3-dichloro-4-fluorohexane.
c) Step 1 There are five carbon atoms in the main chain so the root is -*pentane*-.
Step 2 There are two bromines attached to carbon atom number two so the prefix is 2,2-*dibromo*-.
Step 3 The name is 2,2-dibromo-4-methylpentane.

32.
Problem
Draw condensed structural formulas for the following alkyl halides.

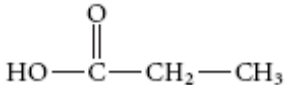
a) bromoethane
b) 2,3,4-triiodo-3-methylheptane

Solution
a) Step 1 The root is -*ethane* so there are two carbon atoms in a continuous chain.
Step 2 The prefix is *bromo*- so it has one bromine attached to carbon atom number one.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.

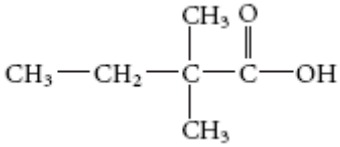
b) Step 1 The root is -*heptane* so there are seven carbon atoms in a continuous chain.
Step 2 The prefix is 2,3,4-*triiodo*-3-*methyl*- so it has one iodine attached to carbon atom number two, one iodine attached to carbon atom number three, and one iodine attached to carbon atom number four. It also has one $-CH_3$ group attached to carbon atom number three.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.



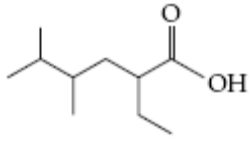
33.
Problem
Name each of the following carboxylic acids.
a)



b)



c)

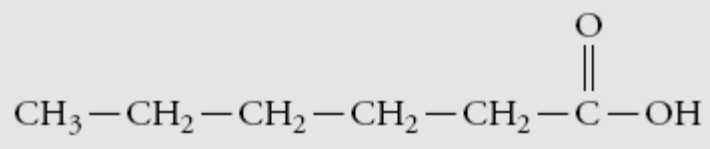


Solution

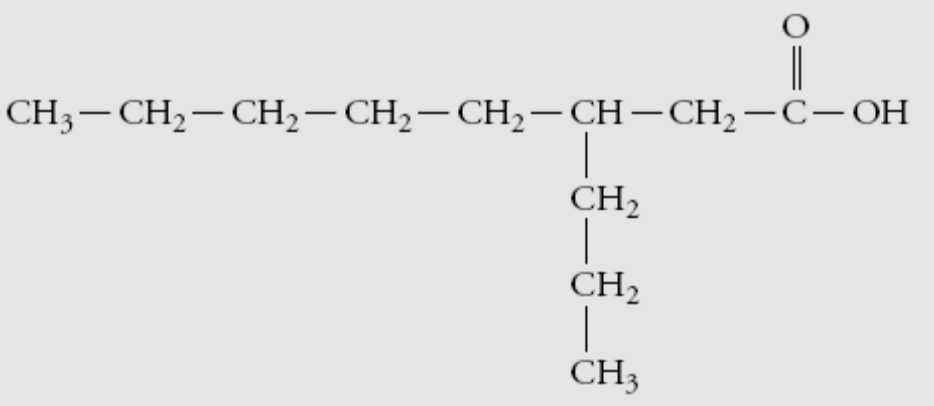
a) Step 1 There are three carbon atoms in the main chain that contains the carboxyl group so the root is -*propane*-.
Step 2 Replace the –*e* at the end of propane with –*oic acid*. The name includes propanoic acid.
b) Step 1 There are four carbon atoms in the main chain that contains the carboxyl group so the root is -*butane*-.
Step 2 Replace the –*e* at the end of butane with –*oic acid*. The name includes butanoic acid.
Step 3 There are two methyl groups attached to carbon atom number two so the prefix is 2,2-*dimethyl*-.
Step 4 The name of the compound is 2,2-dimethylbutanoic acid.
c) Step 1 There are six carbon atoms in the main chain that contains the carboxyl group so the root is -*hexane*-.
Step 2 Replace the –*e* at the end of hexane with –*oic acid*. The name includes hexanoic acid.
Step 3 There is one $-CH_3$ group attached to carbon atom number four and one $-CH_3$ group attached to carbon atom number five. There is one $-CH_2CH_3$ group attached to carbon atom number two so the prefix is 2-*ethyl*-4,5-*dimethyl*-.
Step 4 The name of the compound is 2-ethyl-4,5-dimethylhexanoic acid.

34.
Problem
Draw condensed structural formula for each of the following carboxylic acids.
a) hexanoic acid
b) 3-propyloctanoic acid
c) 3,4-diethyl-2,3,5-trimethylheptanoic acid

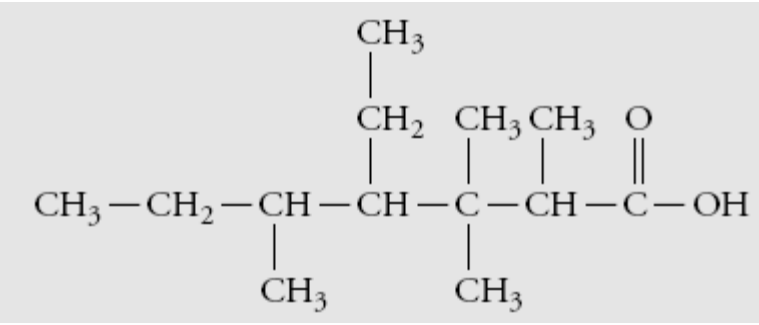
Solution
a) Step 1 The root is *hexane*- so there are six carbon atoms in a continuous chain.
Step 2 The suffix is -*anoic acid* so it has a carboxyl group attached to carbon atom number one.
Step 3 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.



b) Step 1 The root is -*octane*- so there are eight carbon atoms in a continuous chain.
Step 2 The suffix is -*anoic acid* so it has a carboxyl group attached to carbon atom number one.
Step 3 The prefix is 3-*propyl*- so there is one $-CH_2CH_2CH_3$ group attached to carbon atom number three.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.

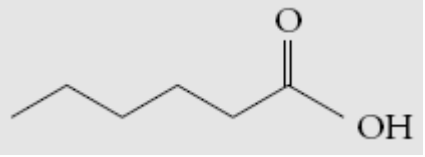


c) Step 1 The root is -*heptane*- so there are seven carbon atoms in a continuous chain.
Step 2 The suffix is -*anoic acid* so it has a carboxyl group attached to carbon atom number one.
Step 3 The prefix is 3,4-diethyl-2,3,5-trimethyl so there is one $–CH_2CH_3$ group attached to carbon atom number three and one $–CH_2CH_3$ group attached to carbon atom number four. There is one $–CH_3$ attached to carbon atom number two, one $–CH_3$ attached to carbon atom number three, and one $–CH_3$ attached to carbon atom number five.
Step 4 All carbon atoms must be bonded to enough hydrogen atoms to give them exactly four bonds.

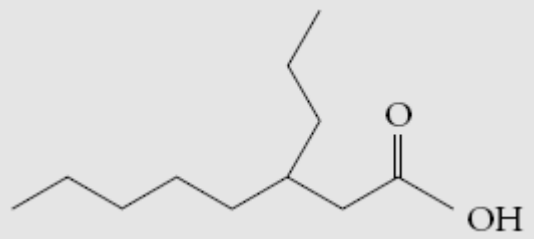


35.
Problem
Draw a line structural formula for each compound in Question 34.

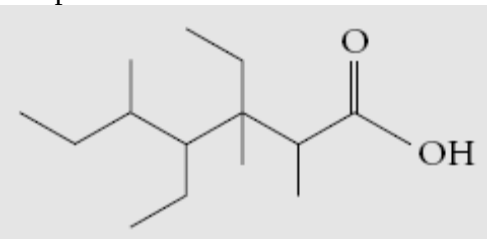
Solution
a) Step 1 The root of the name tells you that there are six carbons and that there are only single bonds between the carbons.
Step 2 Draw a bent line containing six carbons with only single bonds between the atoms.
Step 3 The suffix is -*anoic acid*. Choose which carbon is number one and add the =O and –OH group to carbon number one.
Step 4 Carbon and hydrogen atoms are not shown in a line structural formula. Your drawing is complete.



b) Step 1 The root of the name tells you that there are eight carbons and that there are only single bonds.
Step 2 Draw a bent line containing eight carbons with only single bonds between the atoms.
Step 3 The suffix is -*anoic acid*. Choose which carbon is number one and add the =O and –OH group to carbon number one.
Step 4 The prefix is 3-*propyl*-. Add a propyl line to atom number three on the main chain.
Step 5 Carbon and hydrogen atoms are not shown in a line structural formula. Your drawing is complete.

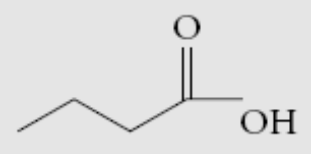


c) Step 1 The root of the name tells you that there are seven carbons and that there are only single bonds.
Step 2 Draw a bent line containing seven carbons with only single bonds between the atoms.
Step 3 The suffix is -*anoic acid*. Choose which carbon is number one and add the =O and –OH group to carbon number one.
Step 4 The prefix is 3,4-*diethyl*-2,3,5-*trimethyl*-. Add one ethyl line to atom number three and one ethyl line to atom number four on the main chain. Add one methyl line to atom number two, one methyl line to atom number 3, and one methyl line to atom number five on the main chain.
Step 5 Carbon and hydrogen atoms are not shown in a line structural formula. Your drawing is complete.

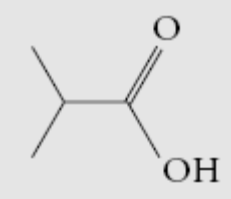


36.
Problem
Draw and name two different carboxylic acids that have the molecular formula $C_4H_8O_2$.

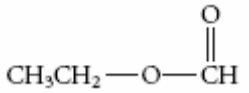
Solution
Butanoic acid has the formula $C_4H_8O_2$.



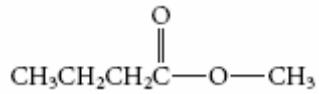
2-methyl-propanoic acid has the formula $C_4H_8O_2$.



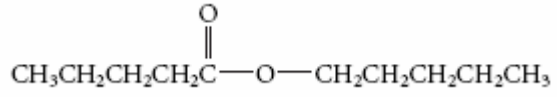
37.
Problem
Name the following esters.
a)



b)



c)

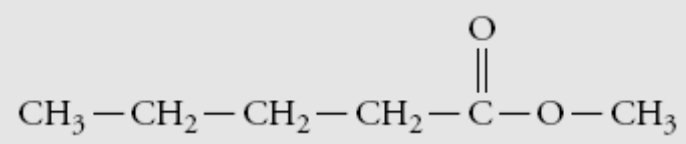


Solution
a) Step 1 There is only one carbon atom in the main group making the parent acid methanoic acid.
Step 2 Remove the *-oic acid* from the name of the parent acid and replace it with *-oate*. The root is now methanoate.
Step 3 The part of the ester that is attached to the parent acid is two carbons long. Therefore, the prefix is ethyl.
Step 4 The name of the compound is ethyl methanoate.
b) Step 1 There are four carbon atoms in the main group making the parent acid butanoic acid.
Step 2 Remove the *-oic acid* from the name of the parent acid and replace it with *-oate*. The root is now butanoate.
Step 3 The part of the ester that is attached to the parent acid is one carbon long. Therefore, the prefix is methyl.
Step 4 The name of the compound is methyl butanoate.
c) Step 1 There are five carbon atoms in the main group making the parent acid pentanoic acid.
Step 2 Remove the *-oic acid* from the name of the parent acid and replace it with *-oate*. The root is now pentanoate.
Step 3 The part of the ester that is attached to the parent acid is five carbons long. Therefore, the prefix is pentyl.
Step 4 The name of the compound is pentyl pentanoate.

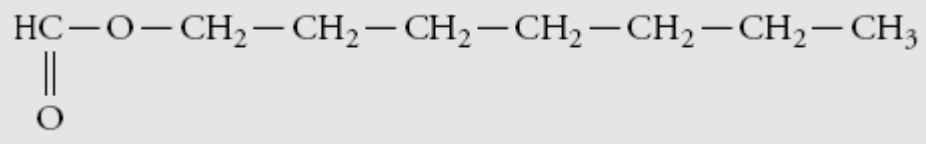
38.
Problem

Draw the following esters:
a) methyl pentanoate
b) heptyl methanoate
c) butyl ethanoate
d) propyl octanoate
e) ethyl 3,3-dimethylbutanoate
f) ethyl octanoate (found in oranges)
g) methylpropyl methanoate (responsible for the aroma of raspberries)

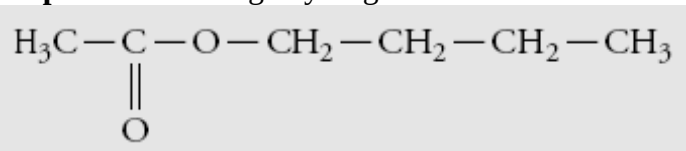
Solution
a) Step 1 The root of the name tells you that there are five carbons and that there are only single bonds.
Step 2 Draw a chain containing five carbons with only single bonds between the atoms.
Step 3 The suffix is *-oate*. Choose carbon number one and attach the =O and the –O to it to create the parent acid.
Step 4 The prefix is *methyl-*. Add one $-CH_3$ to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.



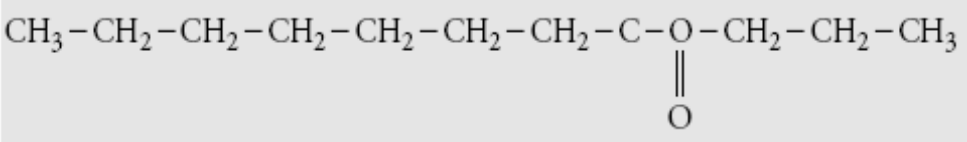
b) Step 1 The root of the name tells you that there is one carbon and that there are only single bonds.
Step 2 Draw the carbon.
Step 3 The suffix is *-oate*. Attach the =O and the –O to the carbon to create the parent acid.
Step 4 The prefix is *heptyl-*. Add $-CH_2CH_2CH_2CH_2CH_2CH_2CH_3$ to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.



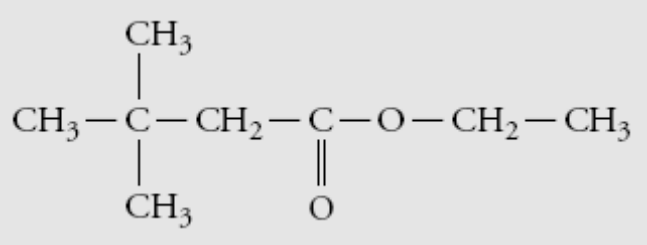
c) Step 1 The root of the name tells you that there are two carbons and that there are only single bonds.
Step 2 Draw a chain containing two carbons with only single bonds between the atoms.
Step 3 The suffix is *-oate*. Attach the =O and the –O to carbon number one to create the parent acid.
Step 4 The prefix is *butyl-*. Add $-CH_2CH_2CH_2CH_3$ to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.



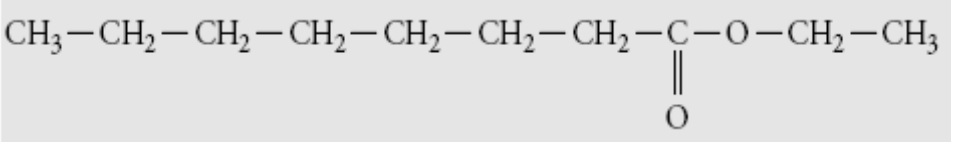
d) Step 1 The root of the name tells you that there are eight carbons and that there are only single bonds.
Step 2 Draw a chain containing eight carbons with only single bonds between the atoms.
Step 3 The suffix is *-oate*. Attach the =O and the –O to carbon number one to create the parent acid.
Step 4 The prefix is *propyl-*. Add $-CH_2CH_2CH_3$ to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.



e) Step 1 The root of the name tells you that there are four carbons and that there are only single bonds.
Step 2 Draw a chain containing four carbons with only single bonds between the atoms.
Step 3 The suffix is *-oate*. Attach the =O and the –O to carbon number one to create the parent acid.
Step 4 The prefix is *ethyl* 3,3-*dimethyl-*. Add two $-CH_3$ groups to carbon atom number three on the main chain. Add $-CH_2CH_3$ to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.



f) Step 1 The root of the name tells you that there are eight carbons and that there are only single bonds.
Step 2 Draw a chain containing eight carbons with only single bonds between the atoms.
Step 3 The suffix is *-oate*. Attach the =O and the –O to carbon number one to create the parent acid.
Step 4 The prefix is *ethyl*. Add one $-CH_2CH_3$ group to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.



g) Step 1 The root of the name tells you that there is only one carbon.
Step 2 Draw the carbon.
Step 3 The suffix is *-oate*. Attach the =O and the –O to the carbon to create the parent acid.
Step 4 The prefix is *methyl propyl*. Add $-CHCH_3CH_2CH_3$ to the single bonded oxygen atom.
Step 5 Attach enough hydrogen atoms so that each carbon atom has four bonds.